Dalian Good Display Co., Ltd

LCD Module User Manual
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REVISION RECORD		
REV. NO.	DATA	REVISION ITEMS
1.0	FEB 27, 2008	First Release Version

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1.Scope

This manual defines general provisions as well as inspection standards for standard LCD module. If the event of unforeseen problem or unspecified items may occur, please contact the nearest supplier or our company.

2.Warranty

If module is not stored or used as specified in this manual, it will be void the 12- month warranty.

3.Features

3-1. Features

(1) Display mode: Transflective type
FSTN LCD

(2) Display color: Display dots: Black
Background:Gray

(3) Display Fonts: Graphic Matrixs

(4)Input data: 8-bit parallel data interfaced from a MPU

(5) Multiplex ratio: 1/65 Duty, 1/9 Bias

(6)Viewing direction: 6 O'clock

(7) Back light: NO

(8) Controller: RA8816

(9) VDD:3.0V

3-2.Mechanical features

Item	Specifications	Unit
Outline dimensions	52.0(W)×56.0(H) ×2.85Max.(T)	mm
Viewing Area	47.0(W)×45.0(H)	mm
Image Area	43.0(W)×38.9(H)	mm
Number of Dots	128(W) ×64(H)	mm
Dot Size	0.285(W)×0.325(H)	mm
Dot Pitch	0.31(W)×0.35(H)	mm
Weight	---	g

3-4.Absolute maximum ratings

Item	Symbol	Condition	Min	Max	Units
Power supply for logic	Vdd	25℃	-0.3	6.5	V
External VLCD voltage range	Vlcd	25℃	-0.3	14.0	V
Input voltage	Vin	25℃	- 0.3	Vdd+0.3	V
Operating temperature	Top	---	- 20	70	℃
Storage temperature	Tstg	---	- 30	80	℃

Note:

1) The modules may be destroyed if they are used beyond absolute maximum ratings. In

ordinary operation, it is desirable to use them within recommended operation conditions.
Using the modules beyond these conditions may cause malfunction and poor reliability.

2) All voltage values are referenced to GND=0V.

3-4 Electrical characteristics (VDD=3.0V, Vss=0V,Ta = 25℃)

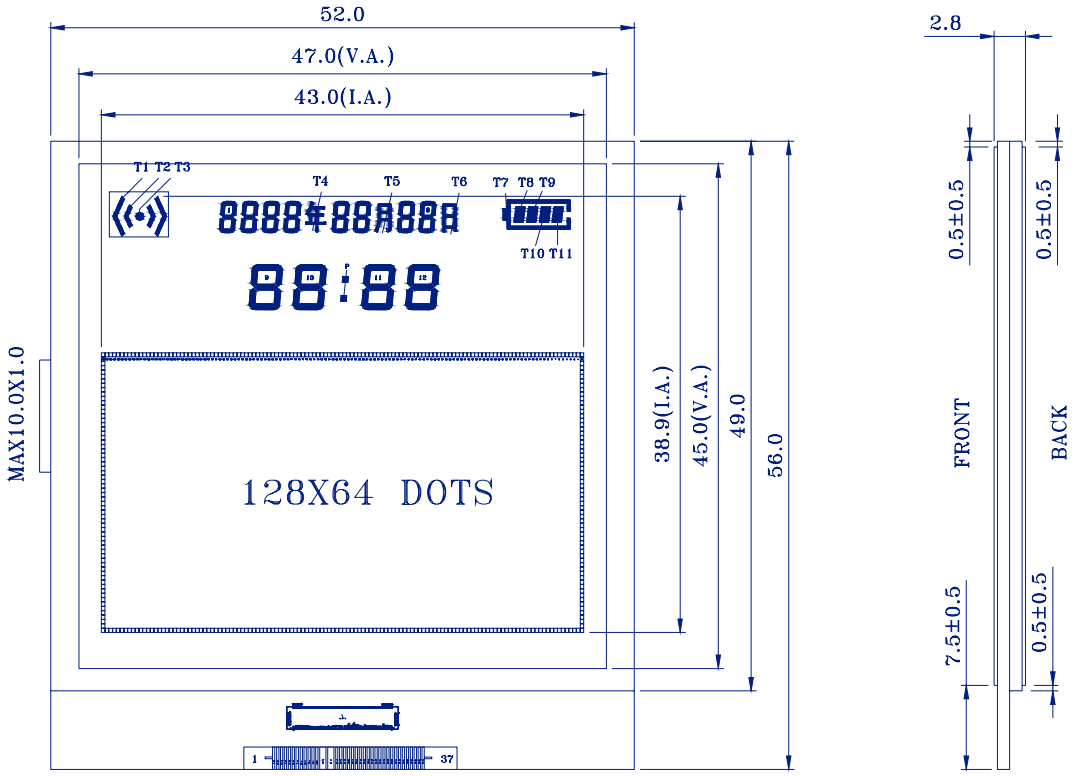
Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply voltage for logic and for converter voltage	Vdd	25℃	2.9	3.0	3.8	V
VLCD Voltage	Vlcd	---	6.0	---	12.0	
Current consumption	Idd	25℃	-	0.7	-	mA
Input High Voltage	Vih	Vdd=3.0V	0.8Vdd	---	Vdd	
Input Low Voltage	Vil	Vdd=3.0V	Vss	---	0.2Vdd	

Note： All the dots are in the static state.

3-5.Electro-Optic Characteristics

NO	Item	Symbol	Min	Typ.	Max	Unit	Condition
1	Supply Voltage(Logic)	Vdd-Vss	---	3.0	---	V	
2	Supply Current (Logic)	Idd	---	0.7	---	mA	Vdd=3.0V
3	LCD Operating Voltage	Vdd-V_0	---	10.2	---	V	-20℃
			---	9.7	---	V	25℃
			---	9.2	---	V	70℃
4	Response Time	Ton	---	280	---	ms	
		Toff	---	60	---	ms	

4. Mechanical Diagram



ICON	SEG
T8	S8
T9	S9
T11	S10
T10	S11
T7	S12
T6	S13
8B	S14
8C	S15
8D	S16
8E	S17
8G	S18
8F	S19
8A	S20
7B	S21
7C	S22
7D	S23
7E	S24
7G	S25
7F	S26
7A	S27
T5	S28
6A	S29
6B	S30
6G	S31
6C	S32
6D	S33
6E	S34
6F	S35
12B	S49
12C	S50
12D	S51
12E	S52
12G	S53
12F	S54
12A	S55
11B	S56
11C	S57
11D	S58
11E	S59
11G	S60
11F	S61
11A	S62
P	S63
10B	S64
10C	S65
10D	S66
10E	S67
10G	S68

ICON	SEG
10F	S69
10A	S70
9B	S71
9C	S72
9D	S73
9E	S74
9G	S75
9F	S76
9A	S77
5B	S88
5C	S89
5D	S90
5E	S91
5G	S92
5F	S93
5A	S94
T4	S95
4B	S96
4C	S97
4D	S98
4E	S99
4G	S100
4F	S101
4A	S102
3B	S103
3C	S104
3D	S105
3E	S106
3G	S107
3F	S108
3A	S109
2B	S110
2C	S111
2D	S112
2E	S113
2G	S114
2F	S115
2A	S116
1B	S117
1C	S118
1D	S119
1E	S120
1G	S121
1F	S122
1A	S123
T3	S125
T2	S126
T1	S127

NOTE:

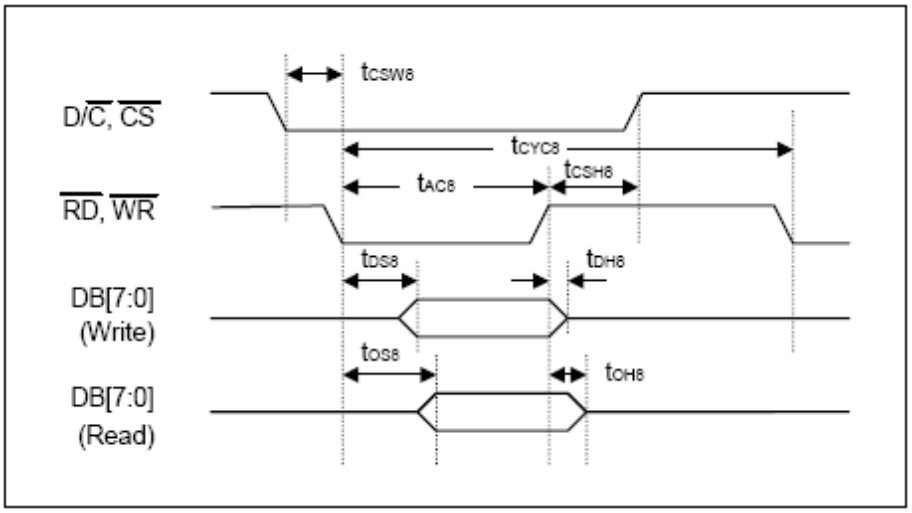
ALL DIMENSIONS ARE IN mm

5.I/O Terminal

5-1 I/O Connection

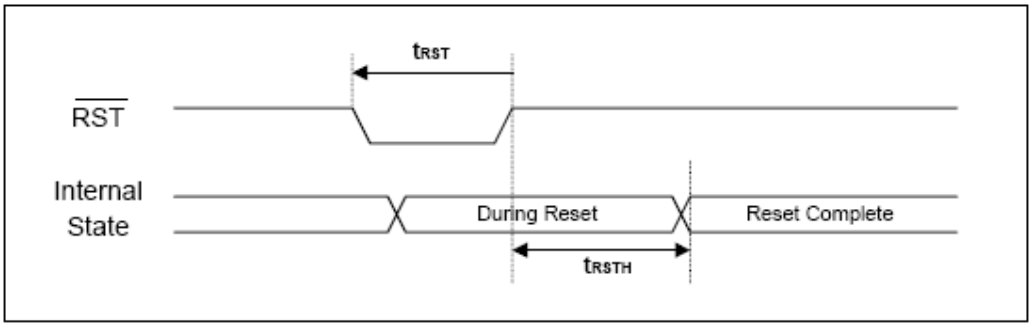
PIN	Symbol	Function
1	VLCD	Booster output.
2	CAP3+	DC/DC voltage converter. connect a capacitor between this pin and the CAP1- pin.
3	CAP2-	DC/DC voltage converter. connect a capacitor between this pin and the CAP2+ pin.
4	CAP2+	DC/DC voltage converter. connect a capacitor between this pin and the CAP2- pin.
5	CAP1-	DC/DC voltage converter. connect a capacitor between this pin and the CAP1+pin.
6	CAP1+	DC/DC voltage converter. connect a capacitor between this pin and the CAP1- pin.
7	V0	This is the multi-level power supply for the liquid crystal drive.the voltage supply applied is Determined by the liquid crystal cell,and is changed through the use of a resistor voltage divided or through changing the impedance using an opamp.Voltage levels are determined based on vss,and must maintain the relative magnitudes shown below: V0≧V1≧V2≧V3≧V4≧VSS.
8	V1	
9	V2	
10	V3	
11	V4	
12	Vref	Voltage reference terminal. connect a capacitor between this pin and VSS.
13	VSS	Ground
14	VDD	Power supply (+3.0V)
15	D7	Data bus line. When the chip select is not active,D0 to D7 may be high Impedance.
16	D6	
17	D5	
18	D4	
19	D3	
20	D2	
21	D1	
22	D0	
23	/RD	8080-series;read enable clock input pin.
24	/WR	8080-series;write enable clock input pin.
25	D/C	Register select input pin. D/C=H,D0 to D7 are display data. D/C=L,D0 to D7 are control data.
26	/CS	Chip select input pin. Data/instruction I/O is enabled only when /CS=L.
27	KST3	Key strobe output
28	KST2	
29	KST1	
30	KST0	
31	KIN4	Key data input
32	KIN3	
33	KIN2	
34	KIN2	
35	KIN1	
36	KIN0	
37	/RST	Reset input pin.When reset is L,initinalization is executed.

5-2 Signal timing diagram(8080 MPU interface)



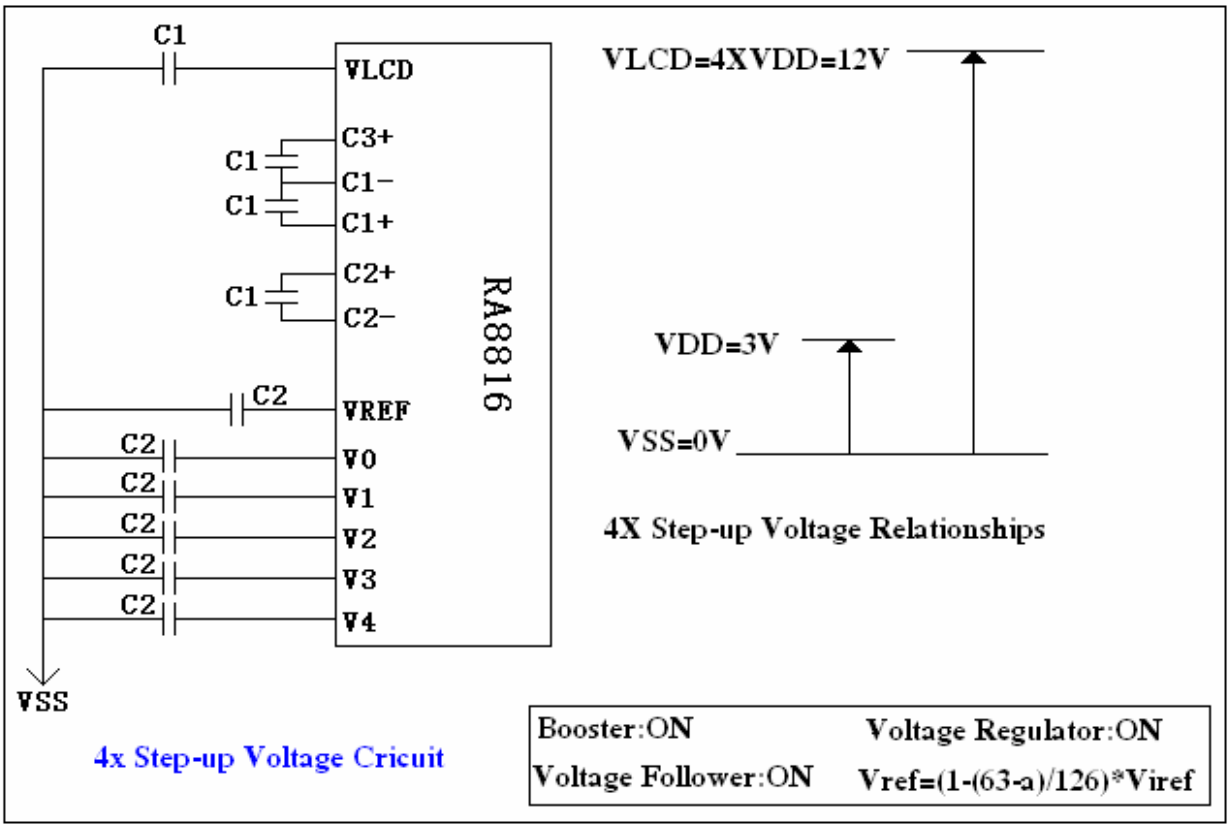
Item	Signal	Symbol	Condition	Rating		Unit
				Min.	Max.	
Address Setup Time	RS, $\overline{CS}$	t_{CSW8}		10	--	ns
Address Hold Time		t_{CSH8}		10	--	
Read/Write Access Time	$\overline{RD}$, $\overline{WR}$	t_{AC8}		90	--	
Access Cycle Time		t_{CYC8}	Command Cycle	200	--	
			Data Cycle	400	--	
Write Data Setup Time	DB[7..0]	t_{DS8}		0	--	
Write Data Hold Time		t_{DH8}		10	--	
Read Data Setup Time		t_{OS8}		30	50	
Read Data Setup Time		t_{OH8}		10	--	

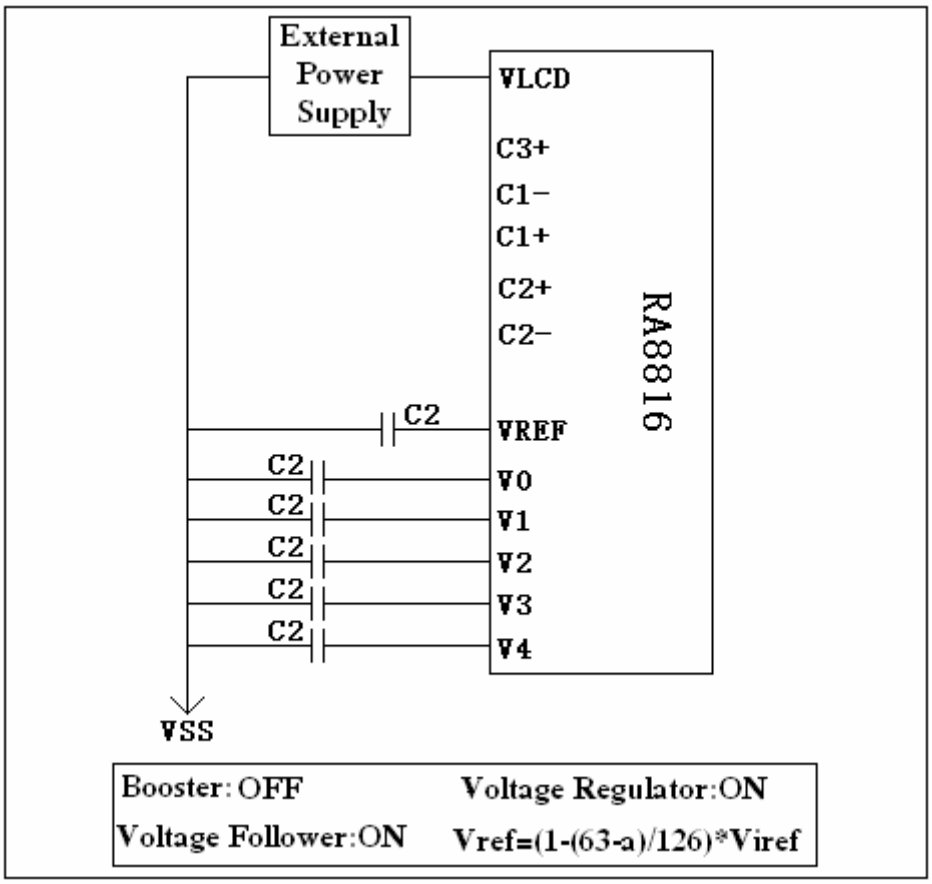
Rest timing

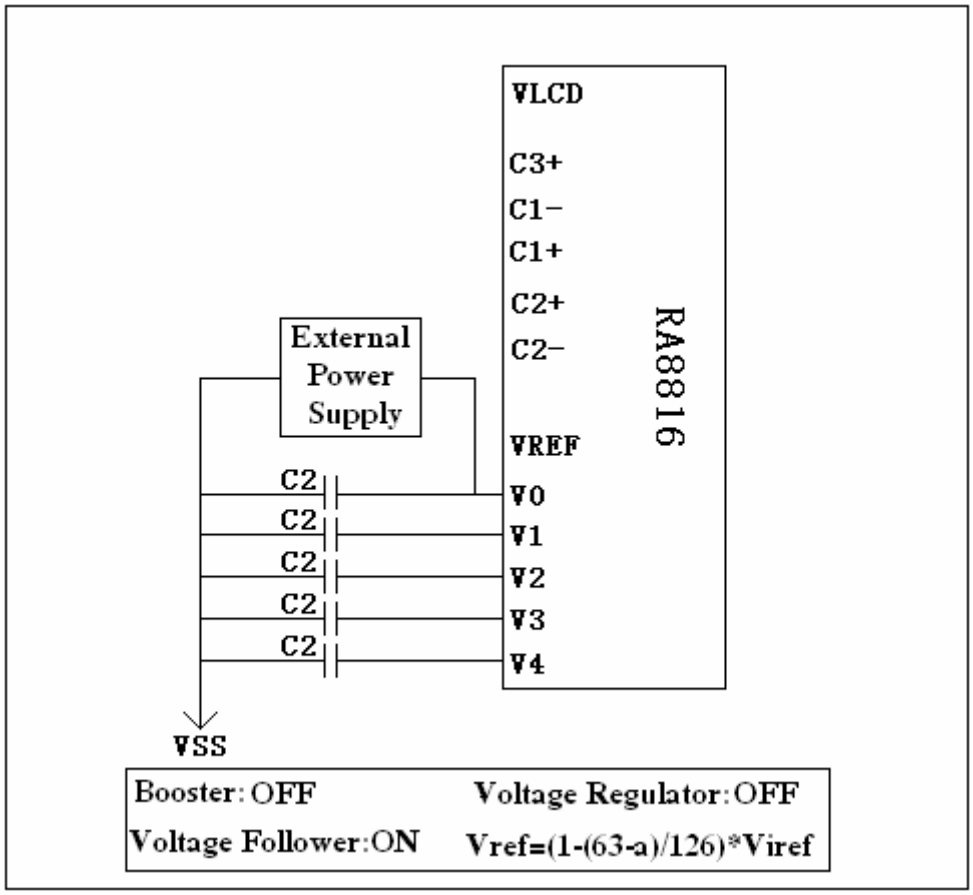


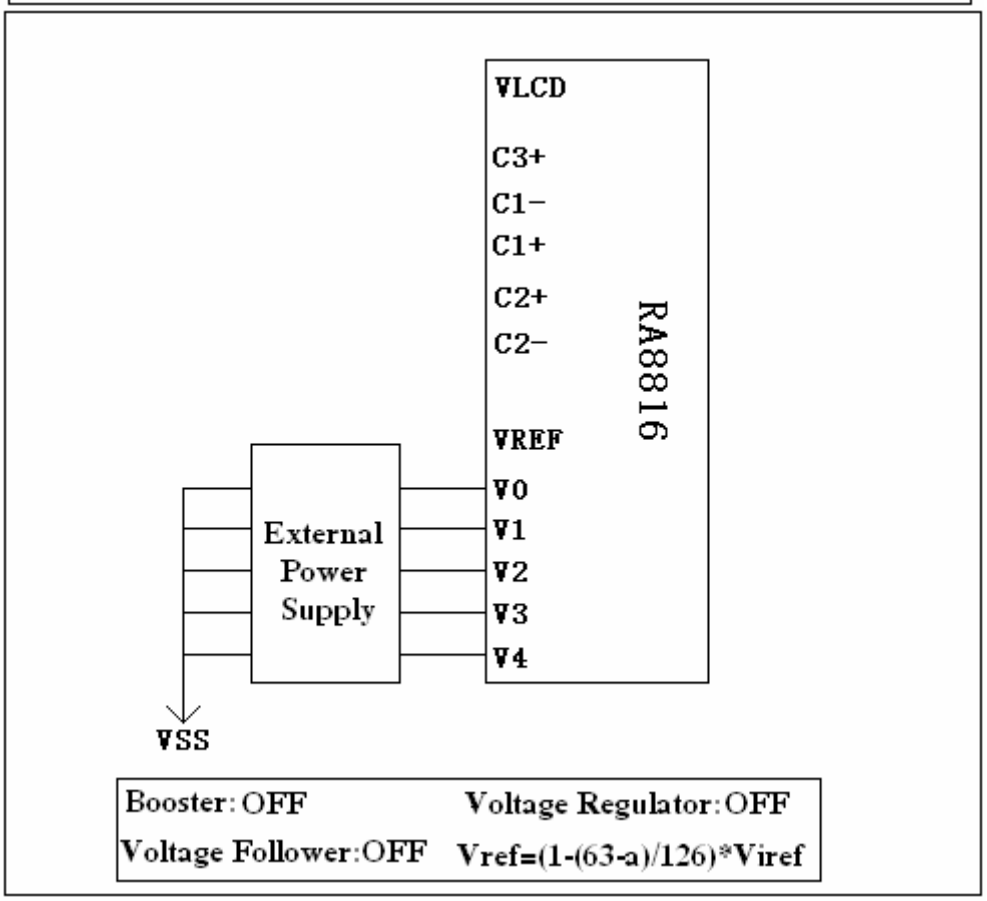
Item	Signal	Symbol	Condition	Rating		Unit
				Min.	Max.	
Reset Pulse Width	$\overline{RST}$	t_{RST}		30	--	ms
Reset Complete Hold Time	$\overline{RST}$	t_{RSTH}	F_{CL}= 100KHz (Internal RC Oscillator)	150	--	ms

5-3 Reference circuit examples






VLCD
C3+
C1−
C1+
C2+
C2−
RA8816
External
Power
Supply
VREF
C2
C2
C2
C2
C2
V0
V1
V2
V3
V4
VSS
Booster: OFF
Voltage Regulator: OFF
Voltage Follower: ON
Vref=(1-(63-a)/126)*Viref


VLCD
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V3
V4
VSS
Booster: OFF
Voltage Regulator: OFF
Voltage Follower: OFF
Vref=(1-(63-a)/126)*Viref

5-4. Instruction Table

ID	Symbol	D7	D6	D5	D4	D3	D2	D1	D0	Function
00	**DWFR**	B/C	---	NW5	NW4	NW3	NW2	NW1	NW0	Driver Waveform Register
01	**PWRR**	SRST	MCLR	---	IO_IEN	KWK	IOWK	DOFF_Z	SLP	Power Control Register
02	**SYSR**	LS3	LS2	LS1	LS0	GB_EN	---	RS1	RS0	System Register
03	**MWMR**	BMOD1	BMOD0	BIEN	ASCS	BOLD	INV	MD1	MD0	Memory Write Mode Register
04	**CURCR**	H3	H2	H1	H0	---	BLK	CR	CUR_EN	Cursor Control Register
05	**X-CUR**	---	---	X5	X4	X3	X2	X1	X0	Cursor Position Register of X
06	**Y-CUR**	---	Y6	Y5	Y4	Y3	Y2	Y1	Y0	Cursor Position Register of Y
07	**KEYR**	KSB	KDB1	KDB0	KSTB_SEL	K_AUTO	IRE	KF1/KSTB1	KF0/KSTB0	Key Scan Control Register
	KSDR	SIRQ	KSTB1	KSTB0	KSD4	KSD3	KSD2	KSD1	KSD0	Key Scan Data Register
		SIRQ	AKD6	AKD5	AKD4	AKD3	AKD2	AKD1	AKD0	
08	**SWSXR**	---	----	---	SSX4	SSX3	SSX2	SSX1	SSX0	Scroll Window Start X Register
09	**SWSYR**	---	---	SSY5	SSY4	SSY3	SSY2	SSY1	SSY0	Scroll Window Start Y Register
0A	**SWRXR**	---	---	---	SRX4	SRX3	SRX2	SRX1	SRX0	Scroll Window Rang X Register
0B	**SWRYR**	PINV	---	SRY5	SRY4	SRY3	SRY2	SRY1	SRY0	Scroll Window Rang Y Register
0C	**SCOR**	SL7	SL6	SL5/SR5	SL4/SR4	SL3/SR3	SL2/SR2	SL1/SR1	SL0/SR0	Scroll Offset Register
0D	**ASCR**	SPD3	SPD2	SPD1	SPD0	STP3	STP2	STP1	STP0	Auto_Scroll Control Register
0E	**SCCR**	SCR_IMD1	SCR_IMD0	SCR_MD	SBUF	SCR_DIR1	SCR_DIR0	SCR_INTEN	AUTO_SCR	Scroll Control Register
0F	**ISR**	BF	---	---	---	IO_I	SCR_I	KI	BI	Interrupt Status Register
10	**CSTR**	BR2	BR1	BR0	CT4	CT3	CT2	CT1	CT0	Contrast Adjust Register
11	**DRCR_A**	BOFF	EN_R	EN_G	ROFF	IDIR	---	CDIR	SDIR	Driver Control Register1
12	**DRCR_B**	CK_BS1	CK_BS0	RR2	RR1	RR0	IRS	HD1	HD0	Driver Control Register2
13	**BLTR**	BLK_EN	PBK_EN	---	INV	BLT3	BLT2	BLT1	BLT0	Blink Timer Register
14	**IODR**	OE7	OE6	OE5	OE4	OE3	OE2	OE1	OE0	I/O Direction Control Register
15	**IODAR**	IOD7	IOD6	IOD5	IOD4	IOD3	IOD2	IOD1	IOD0	I/O Data Register
16	**ELCR**	EL_EN	---	---	---	ELT3	ELT2	ELT1	ELT0	EL Control Register
17	**CGMI**	---	---	---	---	---	UMI2	UMI1	UMI0	CGRAM Register
18	**CGMD**	CGMD7	CGMD6	CGMD5	CGMD4	CGMD3	CGMD2	CGMD1	CGMD0	CGRAM Data Register

6. Quality Level

6-1 Inspection conditions

6-1-1The environmental conditions for inspection shall be as follows:

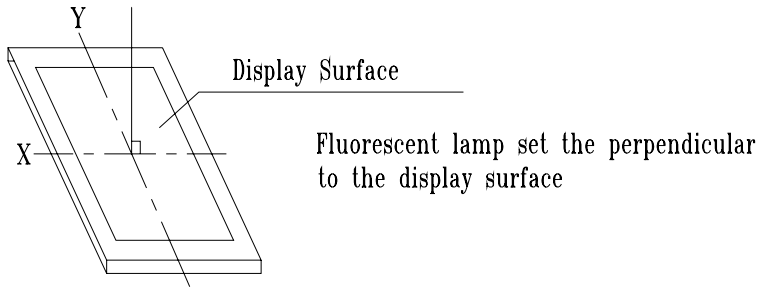
Room temperature: 20±3℃

Humidity: 65±20% RH

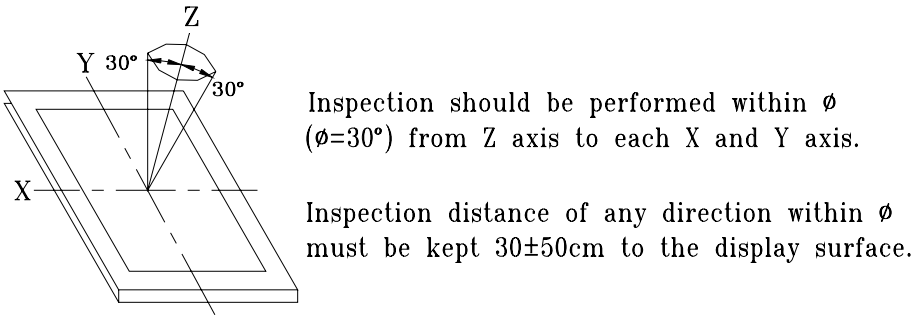
6-1-2 The external visual inspection:

The inspection shall be performed by using a 20W fluorescent lamp for illumination and the distance between LCD and the eyes of the inspector should be at least 30cm.

(1) Light method



(2) Inspection distance and angle


Z
Y 30°
30°
X
Inspection should be performed within ø
(ø=30°) from Z axis to each X and Y axis.
Inspection distance of any direction within ø
must be kept 30±50cm to the display surface.

6-2 Sampling procedures for each item's acceptance level table

Defect type	Sampling procedure	AQL
Major defect	MIL-STD-105D Inspection Level I Normal inspection Single sample inspection	QC/07-2006(1)
Minor defect	MIL-STD-105D Inspection Level I Normal inspection Single sample inspection	QC/07-2006(1)

6-3 Classification of defects

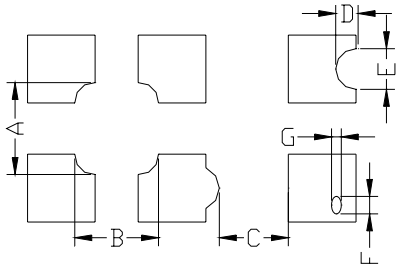
6-3-1 Major defect

A major defect refers to a defect that may substantially degrade usability for product applications.

6-3-2 Minor defect

A minor defect refers to a defect that deviates from existing standards almost unrelated to the effective use of the product or its operation.

6-4 Inspection standar

<table>
<tr><th>Item</th><th>Criterion for defects</th><th>Defect type</th></tr>
<tr><td>1) Display on inspection</td><td>(1) Non display (2) Vertical line is deficient
(3) Horizontal line is deficient (4) Cross line is deficient</td><td>Major</td></tr>
<tr><td>2) Black / White spot</td><td><table><tr><th>Size Φ(mm)</th><th>Acceptable number</th></tr><tr><td>Φ≤0.3</td><td>Ignore (note)</td></tr><tr><td>0.3<Φ≤0.45</td><td>3</td></tr><tr><td>0.45<Φ≤0.6</td><td>1</td></tr><tr><td>0.3<Φ</td><td>0</td></tr></table>(Note) Not allowed if four more spots crowd together</td><td>Minor</td></tr>
<tr><td>3) Black / White line</td><td><table><tr><th>Length (mm)</th><th>Width (mm)</th><th>Acceptable number</th></tr><tr><td>L≤10</td><td>W≤0.03</td><td>Ignore</td></tr><tr><td>5.0≤L≤10</td><td>0.03<W≤0.04</td><td>3</td></tr><tr><td>5.0≤L≤10</td><td>0.04<W≤0.05</td><td>2</td></tr><tr><td>1.0≤L≤10</td><td>0.05<W≤0.06</td><td>2</td></tr><tr><td>1.0≤L≤10</td><td>0.06<W≤0.08</td><td>1</td></tr><tr><td>L≤10</td><td>0.08<W</td><td>follows 2) point defect</td></tr></table>Defects separate with each other at an interval of more than 20mm.</td><td>Minor</td></tr>
<tr><td>4) Display pattern</td><td> 

[Unit: mm]
$\frac{A+B}{2}\leq 0.45$ | $0<C$ | $\frac{D+E}{2}\leq 0.35$ | $\frac{F+G}{2}\leq 0.35$
Note: 1) Up to 3 damages acceptable
2) Not allowed if there are two or more pinholes every 3 of fourths inch.</td><td>Minor</td></tr>
<tr><td>5) Spot-like contrast irregularity</td><td><table><tr><th>Size Φ(mm)</th><th>Acceptable Number</th></tr><tr><td>Φ≤0.7</td><td>Ignore (note)</td></tr><tr><td>0.7<Φ≤1.0</td><td>3</td></tr><tr><td>1.0<Φ≤1.5</td><td>1</td></tr><tr><td>1.5<Φ</td><td>0</td></tr></table>Note: 1) Conformed to limit samples.
2)Intervals of defects are more than 30mm.</td><td>Minor</td></tr>
</table>

Item	Criterion for defects	Defect type
6) Bubbles in polarizer	Size Φ(mm) / Acceptable Number Φ≤0.4 / Ignore (note) 0.4<Φ≤0.65 / 2 0.65<Φ≤1.2 / 1 1.2<Φ / 0	Minor
7) Scratches and dent on the polarizer	Scratches and dent on the polarizer shall be in the accordance with “2) Black/white spot”, and “3) Black/White line”.	Minor
8) Stains on the surface of LCD panel	Stains which cannot be removed even when wiped lightly with a soft cloth or similar cleaning.	Minor
9) Rainbow color	No rainbow color is allowed in the optimum contrast on state within the active area.	Minor
10) Viewing area encroachment	Polarizer edge or line is visible in the opening viewing area due to polarizer shortness or sealing line.	Minor
11) Bezel appearance	Rust and deep damages that are visible in the bezel are rejected.	Minor
12) Defect of land surface contact	Evident crevices that are visible are rejected.	Minor
13) Parts mounting	(1) Failure to mount parts (2) Parts not in the specifications are mounted (3) For example: Polarity is reversed, HSC or TCP falls off.	Major
14) Part alignment	(1) LSI, IC lead width is more than 50% beyond pad outline. (2) More than 50% of LSI, IC leads is off the pad outline.	Minor
15) Conductive foreign matter (solder ball, solder hips)	(1) 0.45<Φ, N≥1 (2) 0.3<Φ≤0.45, N≥1 Φ: Average diameter of solder ball (unit: mm) (3) 0.5<L, N≥1 L: Average length of solder chip (unit: mm)	Major Minor Minor
16) PCB pattern damage	(1) Deep damage is found on copper foil and the pattern is nearly broken. (2) Damage on copper foil other than 1) above	Major Minor
17) Faulty PCB correction	(1) Due to PCB copper foil pattern burnout, the pattern is connected, using a jumper wire for repair;2 or more places are corrected per PCB. (2) Short-circuited part is cut, and no resist coating has been performed.	Minor
18) Bezel flaw	Bezel claw missing or not bent	Minor
19) Indication on name plate (sampling indication label)	(1) Failure to stamp or label error, or not legible.(all acceptable if legible) (2) The separation is more than 1/3 for indication discoloration, in which the characters can be checked.	Minor

7.Reliability

7-1 Lifetime

50,000 hours (25℃ in the room without ray of sun)

7-2 Items of reliability

Item	Condition	Criterion
1) High Temperature Operating	60℃ 96hrs	**No cosmetic failure is allowable.** **Contrast ratio should be between initial value ±10%.** Total current consumption should be below double of initial value.
2) Low Temperature Operation	-20℃ 96hrs	
3) Humidity	40℃, 90%RH, 96hrs	**No cosmetic failure is allowable.** **Contrast ratio should be between initial value ±20%.** Total current consumption should be below double of initial value.
4) High Temperature	70℃ 96hrs	
5) Low Temperature	-30℃ 96hrs	
6) Thermal shock	25℃→30℃→25℃→70℃ 5(min) 30(min) 5(min) 30(min) 5 cycle, 55~60%RH	
7) Vibration	10~55~10hz amplitude: 1.5mm 2hrs for each direction (X,Y,Z)	No defects in cosmetic and operational function are allowable. Total current consumption should be below double of initial value.

8.Handling Precautions

8-1 Mounting method

A panel of LCD module consists of two thin glass plates with polarizers that easily get damaged.
And since the module in so constructed as to be fixed by utilizing fitting holes in the printed circuit board (PCB).
Extreme care should be used when handling the LCD modules.

8-2 Cautions of LCD handling and cleaning

When cleaning the display surface, use soft cloth with solvent (recommended below) and wipe lightly.

- □ Isopropyl alcohol
- □ Ethyl alcohol
- □ Trichlorotriflorothane

Do not wipe the display surface with dry or hard materials that will damage the polarizer surface.
Do not use the following solvent:

- □ Water
- □ Ketone
- □ Aromatics

8-3 Caution against static charge

The LCD module use C-MOS LSI drivers. So we recommend you:
Connect any unused input terminal to V_{dd} or V_{ss}. Do not input any signals before power is turned on, and ground your body, work/assembly areas, assembly equipment to protect against static electricity.

8-4 Packaging

- Module employs LCD elements, and must be treated as such.
  Avoid intense shock and falls from a height.
  To prevent modules from degradation, do not operate or store them exposed direct to sunshine or high temperature/humidity.

8-5 Caution for operation

- It is an indispensable condition to drive LCD module within the limits of the specified voltage since the higher voltage over the limits may cause the shorter life of LCD module.
  An electrochemical reaction due to DC (direct current) causes LCD undesirable deterioration so that the uses of DC (direct current) drive should be avoided.
- Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD module may show dark color in them. However those phenomena do not mean malfunction or out of order of LCD module, which will come back in the specified operating temperature.

8-6 Storage

In the case of storing for a long period of time, the following ways are recommended:

- Storage in polyethylene bag with the opening sealed so as not to enter fresh air outside in it. And with not desiccant.
- Placing in a dark place where neither exposure to direct sunlight nor light is. Keeping the storage temperature range.
- Storing with no touch on polarizer surface by any thing else.

8-7 Safety

- It is recommendable to crash damaged or unnecessary LCD into pieces and to wash off liquid crystal by either of solvents such as acetone and ethanol, which should be burned up later.
- When any liquid leaked out of a damaged glass cell comes in contact with your hands, please wash it off well at once with soap and water.

9.Precautions for Use

9-1 Both parties should provide a limit sample on an occasion when both parties agree its necessity. The judgement by a limit sample shall take effect after the limit sample has been established and confirmed by both parties

9-2 On the following occasions, the handling of problem should be decided through discussion and agreement between responsible of the both parties.

-When a question is arisen in this manual.

-When a new problem is arisen which is not specified in this manual.

-Some problem is arisen due to the change of inspection and operating conditions in users.

-When a new problem is arisen at the customer's operating set for sample evaluation in the customer site.